



Boston Harbor Project Primary Plant

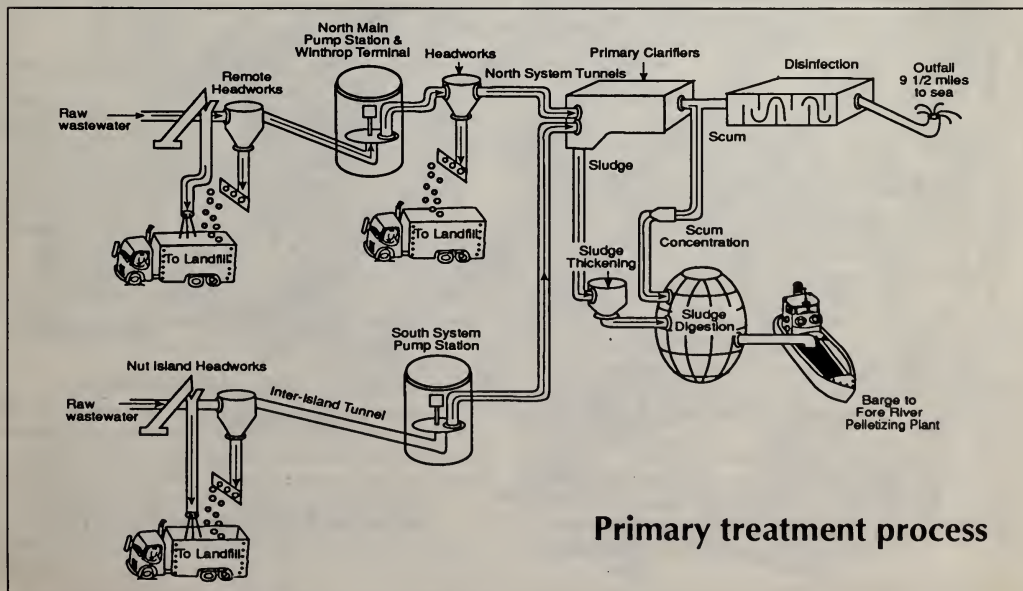
The Massachusetts Water Resources Authority is building a new primary wastewater treatment plant on Deer Island. The centerpiece of the \$6.1 billion Boston Harbor Project, the plant will provide greatly improved sewage treatment for Boston and 42 other cities and towns in eastern Massachusetts. Construction on the primary plant began in December 1990 and is expected to be completed by July 1995. The new plant, which will have a capacity of 1.3 billion gallons per day, will replace existing primary treatment plants at Deer Island, off Winthrop, and Nut Island in Quincy. The new plant will function in concert with other components of the Boston Harbor Project, including a new secondary treatment plant, 14 miles of underwater tunnels, a new headworks at Nut Island and a sludge processing plant at the Fore River Staging Area in Quincy.

The treatment process

Primary treatment is a physical settling process that removes about 60 percent of the solids and up to 40 percent of the toxins in wastewater. Primary treatment also reduces biochemical oxygen demand (BOD) by 35 percent. (BOD measures the amount of oxygen used in a body of water by decomposing materials, an important measure since oxygen supports marine life.) Most of the

floatable materials in wastewater are also removed during primary treatment.

Wastewater treatment begins in headworks, where the flow passes through a series of screens that remove large debris such as tree branches, rags, wood and plastics. The wastewater then travels to grit chambers designed to slow the flow of water enough to allow inorganic materials such as sand and gravel to settle out, while organic solids remain suspended in the water. Materials removed at this



Primary treatment process

step, called grit and screenings, are usually buried in a landfill.

The flows coming from the north and south of Deer Island are combined in the clarifiers, or sedimentation tanks. In the new plant, this flow will be distributed among four batteries containing 48 tanks in all.

The clarifiers hold the wastewater for one or two hours to allow the heavier suspended solids to settle to the bottom of the tanks. The solids, called primary sludge, are scraped from the tanks and pumped to residuals facilities for further treatment.

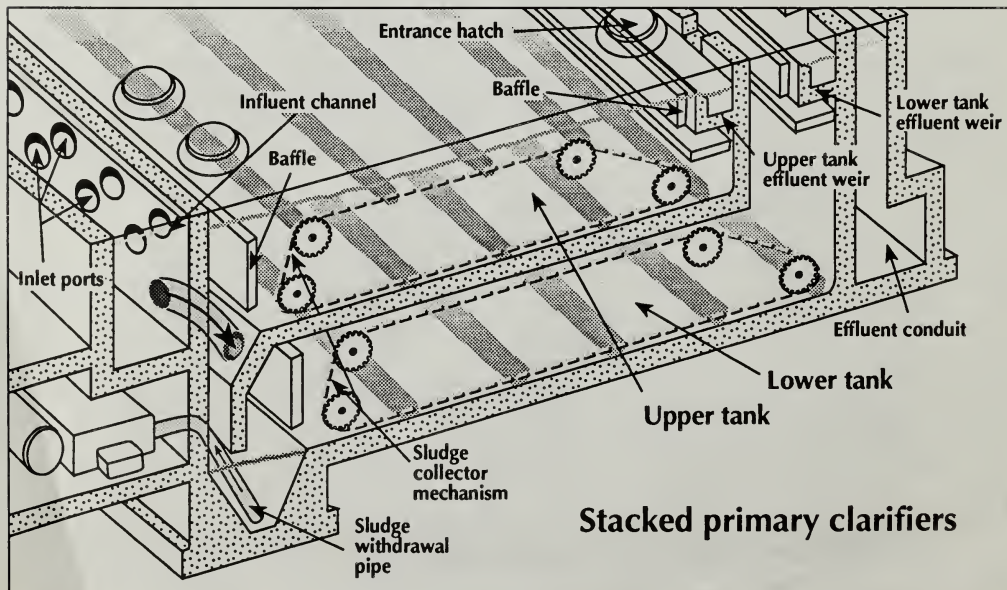
At the same time, floatable substances present in the sewage — such as grease and oil — rise to the surface of the tanks and are removed by a skimming process. The skimmed materials, called scum, are digested along with primary sludge and barged to a pelletizing plant in Quincy for further processing.

The wastewater left in the clarifiers then flows into long effluent channels to the secondary treatment facilities, where the biological treatment process begins.

Secondary treatment removes 85 percent of the solids and 50 to 85 percent of toxins and reduces BOD by 85 percent. The MWRA will begin work on a secondary treatment plant in January 1993. That plant will be completed in phases between 1996 and 2000.

The new primary plant

Sewage (raw wastewater) from 22 communities north and west of Boston will arrive on Deer Island at two existing facilities, the north main pump station and the Winthrop terminal. From there, the sewage will be pumped via two half-mile long tunnels underneath the plant to the north system headworks. The flow then travels to primary clarifiers, where it will be treated. Screened wastewater from 21 South Shore towns will be conveyed from the Nut Island headworks via the inter-island tunnel to the south system pump station on Deer Island, where it will be pumped to the clarifiers for treatment. After primary treatment, the wastewater will be further processed in disinfection basins. The residue of the treatment process will be piped to sludge digesters.



North main pump station and Winthrop terminal

Two elements of the existing plant will be retained for use with the new plant. Modifications of the north main pump station and the Winthrop terminal began in June 1991 to make them compatible with the other components of the new primary treatment plant. The joint venture of J.F. White Contracting Co., of Newton and PFK Mark III, Inc. of Newtown, Pennsylvania, won a \$59 million contract to replace 10 pumps in the north main pump station and six pumps in the Winthrop terminal. The new, more powerful pumps are capable of lifting sewage to the higher elevation of the new primary plant.

J.F. White/PFK Mark is also building a new power substation, odor control facility, surge tanks and piping needed to connect the north system tunnels. The odor control system will treat air from the Winthrop terminal pump station and the tunnel shafts.

The modifications will be completed in two stages to meet court-ordered milestones. The first two batteries of clarifiers will begin operating in July 1994. Two additional batteries will be completed by July 1995 at which time effluent from the new plant will be discharged to Massachusetts Bay via a nine and one-half mile long effluent outfall tunnel.

North system tunnels

From the north main pump station and Winthrop terminal, wastewater from the north system communities will be conveyed to the Deer Island headworks through two half-mile long tunnels. Construction on the north system tunnels, the first component of the primary plant, began in December 1990.

The contractor for the \$20.2 million project is the joint venture of the Kiewit Construction Co. of Omaha, the Guy F. Atkinson Co. of San Francisco and the Kenny Construction Co. of Wheeling, Illinois.

The 85-foot deep tunnels, located on Deer Island, were excavated through soft ground by a 15-foot diameter tunnel boring machine. Excavation of the first tunnel was completed in October 1991; the second tunnel was completed in January 1992. A concrete lining will reduce the diameter of the tunnels to 11 and one-half feet. The vertical shafts at both ends of the tunnels have been excavated and will be lined in steel and encased in concrete.

Construction on the north system tunnels must be completed by June 1992 to enable work to proceed on the new north system headworks. The north system tunnels project is a good example of the tight sequencing needed to meet the court-ordered timetable of the Boston Harbor Project.

North system headworks

The new headworks on Deer Island will provide grit removal for sewage from the Authority's 22 northern communities. Sixteen circular chambers will slow the flow of wastewater enough to allow sand and gravel (called grit) to settle to the bottom. The grit will be removed from the headworks and buried in a landfill. The screened and dewatered wastewater will be directed to primary sedimentation tanks, or clarifiers, for further processing.

The joint venture of Barletta Engineering Corp. of Boston and Daniel O'Connell's Sons Inc. of Holyoke began construction of the headworks in April 1991. When completed, the two-story structure will be approximately 275 feet long by 160 feet wide and located between two odor control facilities also under construction as part of the \$88 million contract. The odor facilities will treat exhaust air from the primary treatment plant. Under the same contract, Barletta/O'Connell is constructing a building to house the control center for the new plant and facilities for the workers who will operate and maintain the new treatment plant.

Primary clarifiers

Once the flow of wastewater has received preliminary treatment to remove large objects and sand and gravel, it enters large settling basins called sedimentation tanks, or clarifiers. The new plant will distribute wastewater among four batteries (or groups) of clarifiers.

The Gust K. Newberg Construction Co. began work in March 1991 on a \$97 million contract to construct the first two batteries, A and B. In March 1992, an \$83 million contract to construct the second set of clarifiers, batteries C and D, was awarded to the George Hyman Construction Co.

Building the batteries in two-story formations will greatly reduce the overall space required for their construction. Batteries A and B are scheduled for completion in March 1994 and C and D in April 1995.

In July 1994, the first two batteries of 24 clarifiers will begin to treat wastewater. The second set will begin operating a year later. From the primary clarifiers, the wastewater will be pumped to basins for disinfection and dechlorination before being released to Boston Harbor. The sludge removed from the clarifiers will be conveyed to the Fore River Staging Area in Quincy for processing at a pelletizing plant.

South system pump station

In November 1991, the Dick Corp. of Pittsburgh began construction of the south system pump station. This circular-shaped building will have the capacity to pump 400 million gallons (mgd) of sewage daily. Eight pumps will be housed in the 80 feet deep, 135 feet wide pump station.

The pump station will convey sewage to the new primary plant from a five-mile tunnel between Nut Island in Quincy and Deer Island. The tunnel, already under construction, will bring screened and dewatered sewage from the MWRA's South Shore communities to Deer Island.

Disinfection basins

At the end of the primary treatment process, the wastewater is disinfected to kill any disease-causing organisms. Disinfection takes place in large basins where the wastewater is treated with sodium hypochlorite. After disinfection, the wastewater is dechlorinated and discharged through the effluent outfall tunnel. Dechlorination, which reduces the level of chlorine to meet federal environmental guidelines for new wastewater treatment plants, will begin in 1995.

Construction of the disinfection basins is scheduled to begin in August 1992 and to be completed in May 1994. From then until July 1995, the disinfected flow will be discharged through the existing outfalls into Boston

Harbor. Beginning in July 1995 — when all four clarifier batteries are in service, a new hydroelectric power station has been built and the effluent outfall tunnel in Massachusetts Bay has been completed — the disinfected and dechlorinated effluent will be discharged nine and one-half miles to sea.

Sludge digesters

Sludge that is removed from the primary clarifiers will undergo processing on Deer Island in large tanks called sludge digesters. The sludge, which consists of fecal matter and other solids, is stabilized in the digesters through a mixing and heating process. The digestion process, which takes 10 to 22 days, cuts the volume of sludge almost by half and reduces bacteria that can cause odor and disease. Methane gas produced by the digesters will be used to fuel the power plant.

The joint venture of the Perini Corp. and Eastern Contractors, Inc., both of Framingham, began construction of the sludge digesters in August 1991. The joint venture is building eight welded steel egg-shaped digesters that rise 110 feet above ground (as high as a five-story building). Each digester has a diameter of 90 feet and a capacity of three million gallons.

Under a \$189 million contract, Perini/Eastern is also constructing six gravity thickener tanks; two large storage tanks to hold digested sludge until it is barged or pumped to Quincy for processing; a three-story concrete support building for the sludge thickener complex; and a two-story concrete support building for the digesters. The support buildings house pumps, controls and odor control facilities.

After processing at Deer Island, the digested liquid sludge will be conveyed to the Authority's sludge processing plant at the Fore River Staging Area in Quincy where it will be converted into fertilizer pellets.

Construction of the first eight digesters will be completed by June 1994. Eight additional digesters, which will process sludge from the secondary treatment plant, will be built between 1993 and 1999 under two separate contracts. There will be a total of 16 digesters on Deer Island.